HIGH HEAT RADIATION METAL COMPOSITE SHEET AND HIGH HEAT RADIATION METAL SUBSTRATE USING THE SAME

Patent number: JP9143649

Publication date: 1997-06-03

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Classification:

- international: C22F1/18; H01L23/373

- european:

Application number: JP19950308885 19951128

Priority number(s):

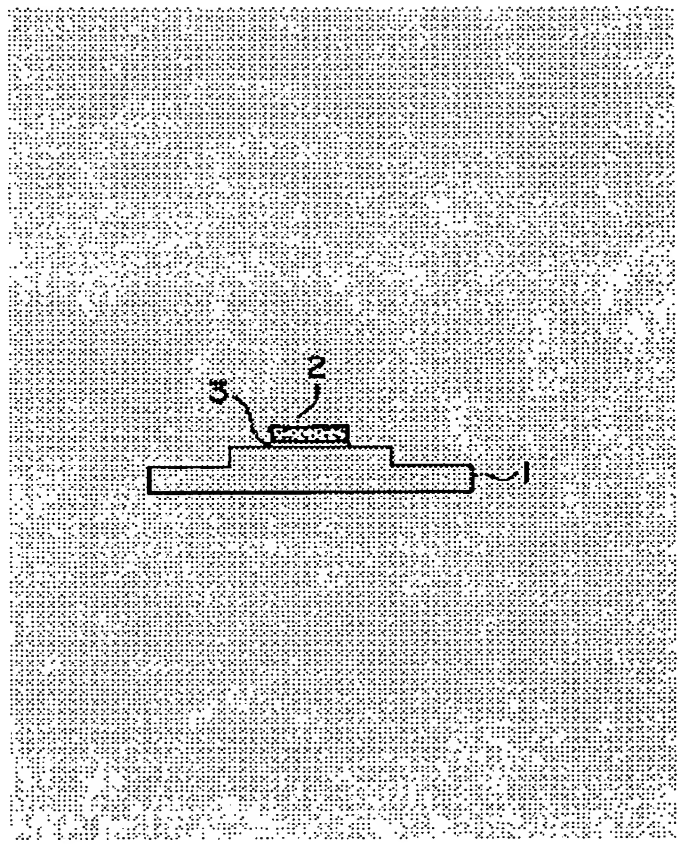
Also published as:

JP9143649 (A)

Abstract of **JP9143649**

PROBLEM TO BE SOLVED: To obtain a high heat radiation metal substrate by using a high heat radiation metal composite sheet having low coefficient of thermal expansion and high heat radiation characteristics, reduced in weight, and excellent in workability.

SOLUTION: A high heat radiation metal composite sheet, which is prepared by subjecting a powder mixture, consisting of, by weight, <40% copper (Cu), 0.5-5% silicon carbide (SiC), and the balance molybdenum (Mo), to compacting and to sintering and then rolling the resultant sintered compact and further has characteristics of 6.0-8.5[× 10<-6> / deg.C] average thermal expansion coefficient, <=10g/cm<3> density, and >=200W/m.K thermal conductivity, is used as a substrate material. Projection stepping is applied to this sheet to form a protrudedly stepped substrate 1. Then, a silicon chip 2 is provided onto the protrudedly stepped substrate 1 by means of a solder 3, by which the high heat radiation metal substrate can be obtained.



(19) 日本国特許庁（JP）

(12) 公開特許公報（A）

(11) 特許出願公開番号

特開平９－１４３６４９

(43) 公開日　平成9年（1997）6月3日

(51) Int. Cl.^{6}	識別記号	庁内整理番号	F I		技術表示箇所
Ｃ２２Ｆ　1/18			Ｃ２２Ｆ　1/18	Ｃ	
Ｈ０１Ｌ　23/373			Ｈ０１Ｌ　23/36	Ｍ	

審査請求　未請求　請求項の数３　ＯＬ　（全４頁）

(21) 出願番号　特願平7-308885

(22) 出願日　平成7年（1995）11月28日

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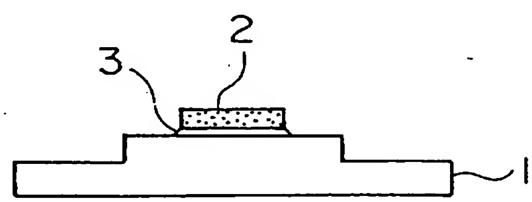
(54)【発明の名称】高放熱性金属複合板材及びそれを用いた高放熱性金属基板

(57)【要約】

【課題】　低熱膨張率で放熱性が高く、しかも軽量で加工性の優れた高放熱性金属複合板材を用いた高放熱性金属基板を提供すること。

【解決手段】　この高放熱性金属基板は、４０ｗｔ％未満の銅（Ｃｕ）及び０．５～５［ｗｔ％］の炭化珪素（ＳｉＣ）と残部モリブデン（Ｍｏ）とを混合して成る混合粉末を成形，焼結した後、圧延することで作製されると共に、平均熱膨張係数が６．０～８．５［$\times 10^{-6}$／℃］の範囲にあって、密度が１０ｇ／ｃｍ^3 以下，熱伝導率が２００Ｗ／ｍ・Ｋ以上の特性を有する基板材料としての高放熱性金属複合板材に凸型段付けを施して凸型段付き基板１を成した後、凸型段付き基板１上に半田３によりシリコンチップ２を設けて構成される。



【特許請求の範囲】

【請求項１】　４０ｗｔ％未満の銅（Ｃｕ）及び０．５～５［ｗｔ％］の炭化珪素（ＳｉＣ）と残部モリブデン（Ｍｏ）とを混合して成る混合粉末を成形，焼結した後、圧延することで作製されると共に、平均熱膨張係数が６．０～８．５［×１０$^{-6}$／℃］の範囲にあることを特徴とする高放熱性金属複合板材。

【請求項２】　請求項１記載の高放熱性金属複合板材において、密度が１０ｇ／ｃｍ^{3} 以下であると共に、熱伝導率が２００Ｗ／ｍ・Ｋ以上の特性を有することを特徴とする高放熱性金属複合板材。

【請求項３】　請求項１又は２記載の高放熱性金属複合板材に段付けを施して得た基板上にシリコン半導体素子を設けて成ることを特徴とする高放熱性金属基板。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、セラミックパッケージ等への組み込みが好適な高放熱性金属複合板材及びそれを用いた高放熱性金属基板に関する。

【０００２】

【従来の技術】従来、半導体素子の支持用電極や搭載用基板は、チップの高密度化，データ伝送の高速化等に伴って使用時の発熱量が増大している。このような発熱量の増大化は、半導体素子の誤動作や劣化，破損等を招く原因となっている。

【０００３】このため、基板材料には基本的な特性として、放熱効果が高く、しかも半導体素子自体やその周辺材料に対して熱膨張係数が近似したできるだけ軽量なものを用いることが望まれている。又、基板材料には半導＊＊体素子自体以外にもこれを搭載した状態の基板を組み込むためのパッケージの材料に対して熱膨張係数が近似しているものを用いることが所望されたり、或いは組立後のマッチングを考慮して半導体素子自体やその周辺材料に対して若干熱膨張係数が異なるものを用いることが所望される場合もある。更に、基板材料には基板をパッケージへ組み込むための準備工程として、臘付けやメッキを施し易いこと等も要求されている。加えて、基板には平板のみならず、凹型や凸型等の段付きタイプのものもあるため、基板材料にはこのような段付け加工が容易であることも要求されている。

【０００４】このような要求を満たし得る高放熱性の基板材料（板材）として、近年ではＣｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）が開発され、既に実用化されている。

【０００５】

【発明が解決しようとする課題】上述したＣｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）の場合、最近の半導体素子用基板材料に対する要求，即ち、低熱膨張率で放熱性が高く、しかも軽量であるという要求を充分に満たし得ないという問題がある。

【０００６】具体的に云えば、下記の表１に示されるように、粉末混合法で作製した幾つかの異なるＣｕ－Ｍｏ混合比のＣｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）特性において、熱膨張率が低ければ放熱性が劣る等，何れのものに関しても上述した最近の基板材料への要求を満たし得ないことが判る。

【０００７】

【表１】

表　1　　TT－RCMの特性

銅　質　量　%	0 (Mo)	20	40	60	80	100(Cu)
密　度 (g／cm^{3})	10.2	9.9	9.6	9.4	9.2	8.9
熱膨張係数 (×10^{-6}／℃)	5.1	7.5	8.7	12.3	15.9	17.0
熱伝導率 (W／m・K)	142	170	234	280	338	394

【０００８】この表１からは、例えば銅（Ｃｕ）の含有量が４０ｗｔ％以上のものに関しては、熱伝導率が高いものの、熱膨張係数がやや大きくなっていることが判る。このため、このようなＣｕ－Ｍｏ混合比のものをセラミックパッケージ組み込み用の基板材料として用いると、セラミックパッケージとのミスマッチングのために亀裂等が発生してしまう危険がある。

【０００９】これに対し、銅（Ｃｕ）の含有量が４０ｗｔ％未満のものについては、熱膨張係数が小さいことにより、セラミックパッケージ組み込み用の基板材料として用いればセラミックパッケージとのマッチング性が良好となるという利点があるが、この反面，熱伝導率が小さいことにより、チップで発生する熱を逃がし難くなって誤動作等を招く危険性があり、信頼性が損われてしまう。

【００１０】即ち、従来のＣｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）の場合、最近の半導体素子用基板材料に対する要求を満たし得ず、セラミックパッケージへの組み込み用の基板材料として用いる場合にも機械加工性が悪く、適用し難いという問題がある。

【００１１】ところで、Ｃｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）以外の基板材料，即ち、熱膨張係数が８．５×１０$^{-6}$／℃以下で熱伝導率が２００Ｗ／ｍ・Ｋ以上の基板材料として、銅－タングステン（ＣＭＳＨ）が知られているが、この銅－タングステン（ＣＭＳＨ）は密度が１５．６～１７［ｇ／ｃｍ^{3}］と大きく、軽量化の具現に難がある上、機械加工性が悪いこと等により、上述したＣｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）の場合と同様に、最近の半導体素子用基板材料としては実用に適さない。

【００１２】本発明は、このような問題点を解決すべくなされたもので、その技術的課題は、低熱膨張率で放熱性が高く、しかも軽量で機械加工性の優れた高放熱性金属複合板材及びそれを用いた高放熱性金属基板を提供することにある。

【００１３】

【課題を解決するための手段】本発明によれば、４０ｗｔ％未満の銅（Ｃｕ）及び０．５～５［ｗｔ％］の炭化珪素（ＳｉＣ）と残部モリブデン（Ｍｏ）とを混合して成る混合粉末を成形，焼結した後、圧延することで作製されると共に、平均熱膨張係数が６．０～８．５［$\times 10^{-6}$／℃］の範囲にある高放熱性金属複合板材が得られる。

【００１４】又、本発明によれば、上記高放熱性金属複合板材において、密度が１０ｇ／ｃｍ^{3}以下であると共に、熱伝導率が２００Ｗ／ｍ・Ｋ以上の特性を有する高放熱性金属複合板材が得られる。

【００１５】更に、本発明によれば、上記何れかの高放熱性金属複合板材に段付けを施して得た基板上にシリコン半導体素子を設けて成る高放熱性金属基板が得られる。

【００１６】

【発明の実施の形態】以下に実施例を挙げ、本発明の高放熱性金属複合板材及びそれを用いた高放熱性金属基板について、図面を参照して詳細に説明する。

【００１７】最初に、本発明の高放熱性金属複合板材の概要を簡単に説明する。この高放熱性金属複合板材は、４０ｗｔ％未満の銅（Ｃｕ）及び０．５～５［ｗｔ％］の炭化珪素（ＳｉＣ）と残部モリブデン（Ｍｏ）とを混合して成る混合粉末を成形，焼結した後、圧延することで作製される。この高放熱性金属複合板材の諸特性は、平均熱膨張係数が６．０～８．５［$\times 10^{-6}$／℃］の範囲にあり、密度が１０ｇ／ｃｍ^{3}以下であると共に、熱伝導率が２００Ｗ／ｍ・Ｋ以上となっている。

【００１８】このような高放熱性金属複合板材に段付け加工により段付けを施して基板を成し、その基板上にシリコン半導体素子を設ければ、セラミックパッケージへの組み込みが好適な高放熱性金属基板として構成される。

【００１９】そこで、以下は幾つかの実施例に基づいて材料組成比（組成含有量）が異なる高放熱性金属複合板材について、その製造方法を合わせて具体的に説明する。

【００２０】＜実施例１＞実施例１では、先ず原料粉末として、モリブデン（Ｍｏ）粉末，電解銅（Ｃｕ）粉末，及び炭化珪素（ＳｉＣ）粉末を７０：３０：３．１の割合で混合し、プレス成形した後、水素雰囲気中で焼結した。次に、この焼結体を水素雰囲気中にて９００℃で１５分間加熱保持した後、熱間圧延加工してから冷間圧延加工を施すことで厚さ１．０ｍｍの板材に仕上げた。

【００２１】そこで、この板材の諸特性を調べたところ、熱膨張係数（α）は７．５$\times 10^{-6}$／℃，熱伝導率（κ）は２２０Ｗ／ｍ・Ｋ，密度（ρ）は９．７ｇ／ｃｍ^{3}であった。

【００２２】又、この板材に電解で膜厚が３μｍとなるようにニッケル（Ｎｉ）メッキを成膜した後、水素雰囲気中にて８５０℃×２０分の条件下で熱処理して成膜加工性を調べたところ、メッキに関して膨れ，変色，染み等の変質は無く、不良は認められなかった。

【００２３】因みに、比較として炭化珪素（ＳｉＣ）を含まずにモリブデン（Ｍｏ）粉末：電解銅（Ｃｕ）粉末を７０：３０として同様な手順で作製した板材に関して諸特性を調べたところ、熱膨張係数（α）は７．７$\times 10^{-6}$／℃，熱伝導率（κ）は１９０Ｗ／ｍ・Ｋ，密度（ρ）は９．７ｇ／ｃｍ^{3}であった。

【００２４】＜実施例２＞実施例２では、原料粉末として、モリブデン（Ｍｏ）粉末，電解銅（Ｃｕ）粉末，及び炭化珪素（ＳｉＣ）粉末を７０：３０：４．２の割合で混合し、この後は実施例１と同様な手順を経て厚さ１．０ｍｍの板材を作製した。

【００２５】そこで、この板材の諸特性を調べたところ、熱膨張係数（α）は７．３$\times 10^{-6}$／℃，熱伝導率（κ）は２３０Ｗ／ｍ・Ｋ，密度（ρ）は９．７ｇ／ｃｍ^{3}であった。

【００２６】又、ここでは実施例１の場合と同様にＮｉメッキを施し、熱処理した後、更にシリコンウエハーに銀臘（ＢＡｇ－８）付けを行ったところ、Ｎｉメッキ及び銀臘の密着加工性は良好で、亀裂や剥離等の不良が認められなかった。

【００２７】因みに、ここでも比較として炭化珪素（ＳｉＣ）を含まずにモリブデン（Ｍｏ）粉末：電解銅（Ｃｕ）粉末を７０：３０として作製した板材に関して同様に臘付けまでの工程を行ったところ、臘付け部に亀裂が認められ、密着加工性が劣化されることが判った。

【００２８】＜実施例３＞実施例３では、原料粉末として、モリブデン（Ｍｏ）粉末、電解銅（Ｃｕ）粉末，及び炭化珪素（ＳｉＣ）粉末を８０：２０：４．２の割合で混合し、実施例１と同様な手順を経て厚さ１ｍｍの板材を作製した。

【００２９】そこで、この板材の諸特性を調べたところ、熱膨張係数（α）は６．７$\times 10^{-6}$／℃，熱伝導率（κ）は２１０Ｗ／ｍ・Ｋ，密度（ρ）は９．８ｇ／ｃｍ^{3}であった。

【００３０】又、ここでも実施例２の場合と同様にＮｉメッキや銀臘付けを施して密着加工性を調べたところ、良好であった。

【００３１】因みに、ここでも比較として炭化珪素（ＳｉＣ）を含まずにモリブデン（Ｍｏ）粉末：電解銅（Ｃｕ）粉末を８０：２０として同様な手順で作製した板材

に関して諸特性を調べたところ、熱膨張係数（α）は６．９×１０$^{-6}$／℃，熱伝導率（κ）は１７５Ｗ／ｍ・Ｋ，密度（ρ）は９．９ｇ／ｃｍ^3 であった。

【００３２】＜実施例４＞実施例４では、原料粉末として、モリブデン（Ｍｏ）粉末、電解銅（Ｃｕ）粉末，及び炭化珪素（ＳｉＣ）粉末を９０：１０：５．３の割合で混合し、実施例１と同様な手順を経て厚さ１ｍｍの板材を作製した。

【００３３】そこで、この板材の諸特性を調べたところ、熱膨張係数（α）は６．０×１０$^{-6}$／℃，熱伝導率（κ）は２０２Ｗ／ｍ・Ｋ，密度（ρ）は１０．０ｇ／ｃｍ^{3}であった。

【００３４】因みに、ここでも比較として炭化珪素（ＳｉＣ）を含まずにモリブデン（Ｍｏ）粉末：電解銅（Ｃｕ）粉末を９０：１０として同様な手順で作製した板材に関して諸特性を調べたところ、熱膨張係数（α）は６．２×１０$^{-6}$／℃，熱伝導率（κ）は１６３Ｗ／ｍ・Ｋ，密度（ρ）は１０．０ｇ／ｃｍ^3 であった。

【００３５】尚、以上の各実施例（１～４）で用いられたＳｉＣ粉末に関し、その粒径は１～３［μｍ］であり、諸特性は密度（ρ）が２．５ｇ／ｃｍ^3，熱膨張係数（α）が３．１×１０$^{-6}$／℃，熱伝導率（κ）が２８０Ｗ／ｍ・Ｋである。

【００３６】各実施例（１～４）からは、既知の粉末混合法によるＣｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）の作製に際してＣｕの含有量を４０ｗｔ％未満に規制した上、０．５～５［ｗｔ％］のＳｉＣ粉末を添加して高放熱性金属複合板材を得ると、軽量化及び低熱膨張化が具現され、高放熱性が向上する上、機械加工性も良好となることが判る。

【００３７】ところで、以上の各実施例（１～４）で得られた各板材に対し、図１に示されるように、段付け加工により凸型段付けを施して４種の別個な凸型段付基板１を作製した後、これらの各凸型段付基板１上に半田３によりそれぞれシリコンチップ２を設けて４種の高放熱性金属基板を得た後、これらの各高放熱性金属基板をセラミックパッケージに組み込んだ状態で熱サイクルテストを行ったところ、何れの場合に関しても亀裂等の発生が無く、接合界面からの剥離も認められなかった。又、実際の組み立て状態における放熱性は従来のものと比べて大幅に向上していることも判った。

【００３８】

【発明の効果】以上に述べた通り、本発明によれば、既知の粉末混合法によるＣｕ－Ｍｏ系複合材料（ＴＴ－ＲＣＭ）の作製に際してＣｕの含有量を４０ｗｔ％未満に規制した上、０．５～５［ｗｔ％］のＳｉＣ粉末を添加することにより、低熱膨張率で放熱性が高く、しかも軽量で機械加工性の優れた高放熱性金属複合板材が得られるようになる。又、この高放熱性金属複合板材を基板材料として用いて段付けを施して基板を作製し、その基板上にシリコン半導体素子を設ければ、特にセラミックパッケージへの組み込みが好適で有効な高放熱性金属基板が得られるようになる。

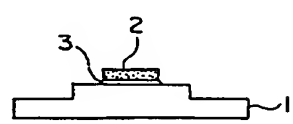
【図面の簡単な説明】

【図１】本発明の高放熱性金属複合板材を用いて構成される一実施例に係る高放熱性金属基板の基本構成を示した側面図である。

【符号の説明】

１　凸型段付き基板
２　シリコンチップ
３　半田

【図１】



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-143649
(43)Date of publication of application : 03.06.1997

(51)Int.Cl.	C22F 1/18 H01L 23/373

(21)Application number : 07-308885
(22)Date of filing : 28.11.1995

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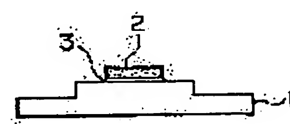
ICHIDA AKIRA

(54) HIGH HEAT RADIATION METAL COMPOSITE SHEET AND HIGH HEAT RADIATION METAL SUBSTRATE USING THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a high heat radiation metal substrate by using a high heat radiation metal composite sheet having low coefficient of thermal expansion and high heat radiation characteristics, reduced in weight, and excellent in workability.
SOLUTION: A high heat radiation metal composite sheet, which is prepared by subjecting a powder mixture, consisting of, by weight, <40% copper (Cu), 0.5-5% silicon carbide (SiC), and the balance molybdenum (Mo), to compacting and to sintering and then rolling the resultant sintered compact and further has characteristics of 6.0-8.5[×10-6/°C] average thermal expansion coefficient, ≤10g/cm3 density, and ≥ 200W/m.K thermal conductivity, is used as a substrate material. Projection stepping is applied to this sheet to form a protrudedly stepped substrate 1. Then, a silicon chip 2 is provided onto the protrudedly stepped substrate 1 by means of a solder 3, by which the high heat radiation metal substrate can be obtained.



LEGAL STATUS

[Date of request for examination]	24.07.2000
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3482580
[Date of registration]	17.10.2003
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection]	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] The high heat dissipation nature metal compound plate characterized by an average coefficient of thermal expansion being in the range of 6.0-8.5 [x10-6/degree C] while being produced by rolling out, after fabricating the mixed powder which mixes and changes and sintering the copper below 40wt% (Cu), and the silicon carbide (SiC) and remainder molybdenum (Mo) of 0.5-5 [wt%].
[Claim 2] It sets to a high heat dissipation nature metal compound plate according to claim 1, and consistencies are 10 g/cm3. High heat dissipation nature metal compound plate characterized by thermal conductivity having the property of 200 or more W/m-K while being the following.
[Claim 3] The high heat dissipation nature metal substrate characterized by preparing a silicon semiconductor device and changing on the substrate which performed and obtained joggling to the high heat dissipation nature metal compound plate according to claim 1 or 2.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the high heat dissipation nature metal substrate with which the inclusion to a ceramic package etc. used a suitable high heat dissipation nature metal compound plate and suitable it.
[0002]
[Description of the Prior Art] Conventionally, as for the electrode for support and the substrate for loading of a semiconductor device, the calorific value at the time of use is increasing with the densification of a chip, improvement in the speed of data transmission, etc. Such increase-ization of calorific value is the cause which causes malfunction of a semiconductor device, degradation, breakage, etc.
[0003] For this reason, as a property fundamental to a substrate ingredient, the heat dissipation effectiveness is high, and to use the lightweight thing which the coefficient of thermal expansion moreover approximated to the semiconductor device itself and its circumference ingredient is desired as it can do. Moreover, to use what the coefficient of thermal expansion approximates to the substrate ingredient to the ingredient of the package for incorporating the substrate in the condition of having carried this besides the semiconductor device itself may be wished, or to use that from which a coefficient of thermal expansion differs a little to the semiconductor device itself and its circumference ingredient in consideration of matching after assembly may be wished. Furthermore, the substrate ingredient is required to be easy to perform ** attachment and plating etc. as a preparation process for building a substrate into a package. In addition, it is required for the substrate that such joggling processing should also be easy not only for a plate but the thing of types with a stage, such as a concave and a convex type, into a substrate ingredient for a certain reason.
[0004] As a substrate ingredient (plate) of high heat dissipation nature which may fill such a demand, in recent years, Cu-Mo system composite material (TT-RCM) is developed, and it is already put in practical use.
[0005]
[Problem(s) to be Solved by the Invention] In the case of the Cu-Mo system composite material (TT-RCM) mentioned above, there is a problem that heat dissipation nature is high and moreover cannot fully fill with the demand to the latest substrate ingredient for semiconductor devices, i.e., a low-fever expansion coefficient, demand of being lightweight.
[0006] Cu-Mo some which were produced with powder alligation differing, speaking concretely, as shown in the following table 1 -- in the Cu-Mo system composite-material (TT-RCM) property of a mixing ratio, if coefficient of thermal expansion is low, it turns out that a demand into the latest substrate ingredient mentioned above also about which thing -- heat dissipation nature is inferior -- must have been filled.
[0007]
[Table 1]

表 1　TT−RCMの特性

銅質量%	0 (Mo)	20	40	60	80	100(Cu)
密度 (g/cm^3)	10.2	9.9	9.6	9.4	9.2	8.9
熱膨張係数 $(\times 10^{-6}/°C)$	5.1	7.5	8.7	12.3	15.9	17.0
熱伝導率 $(W/m \cdot K)$	142	170	234	280	338	394

[0008] This table 1 shows that the coefficient of thermal expansion is a little large, although the copper (Cu) content of thermal conductivity is high about the thing beyond 40wt%. for this reason, such Cu-Mo -- when the thing of a mixing ratio is used as a substrate ingredient for ceramic package inclusion, there is risk of a crack etc. occurring for mismatching with a ceramic package.
[0009] On the other hand, although there is an advantage that matching nature with a ceramic package becomes good if a copper (Cu) content uses as a substrate ingredient for ceramic package inclusion according to a coefficient of thermal expansion being small about the thing below 40wt%, there is a danger of being hard coming to miss the heat generated with a chip, and on the other hand causing malfunction etc. by the heat conductivity being small, and dependability will be spoiled.
[0010] That is, in the case of the conventional Cu-Mo system composite material (TT-RCM), also when the demand to the latest substrate ingredient for semiconductor devices must have been filled and it uses as a substrate ingredient for the inclusion to a ceramic package, there is a problem of machinability being bad and being hard to apply it.
[0011] By the way, although the copper-tungsten (CMSH) is known for less than [8.5x10-6/degree C] for thermal conductivity as a substrate ingredient of 200 or more W/m-K, substrate ingredients other than Cu-Mo system composite material (TT-RCM), i.e., a coefficient of thermal expansion According to this copper-tungsten (CMSH) having a consistency as large as 15.6-17 [g/cm3], and machinability when difficulty is in the embodiment of lightweight-izing being bad etc. As latest substrate ingredient for semiconductor devices, it is not suitable for practical use like the case of the Cu-Mo system composite material (TT-RCM) mentioned above.
[0012] Made that this invention should solve such a trouble, the technical technical problem has high heat dissipation nature, moreover is lightweight at a low-fever expansion coefficient, and is to offer the high heat dissipation nature metal substrate which used the high heat dissipation nature metal compound plate and it which were excellent in machinability.
[0013]
[Means for Solving the Problem] After fabricating the mixed powder which mixes and changes and sintering the copper below 40wt% (Cu), and the silicon carbide (SiC) and remainder molybdenum (Mo) of 0.5-5 [wt%], while being produced by rolling out according to this invention, the high heat dissipation nature metal compound plate which has an average coefficient of thermal expansion in the range of 6.0-8.5 [x10-6/degree C] is obtained.
[0014] Moreover, according to this invention, it sets to the above-mentioned quantity heat dissipation nature metal compound plate, and consistencies are 10 g/cm3. While being the following, the high heat dissipation nature metal compound plate in which thermal conductivity has the property of 200 or more W/m-K is obtained.
[0015] furthermore -- according to this invention -- the above -- the high heat dissipation nature metal substrate which prepares a silicon semiconductor device and changes on the substrate which performed and obtained joggling to which high heat dissipation nature metal compound plate is obtained.
[0016]
[Embodiment of the Invention] An example is given to below and the high heat dissipation nature metal substrate which used the high heat dissipation nature metal compound plate of this invention and it is explained to a detail with reference to a drawing.
[0017] First, the outline of the high heat dissipation nature metal compound plate of this invention is explained briefly. After this high heat dissipation nature metal compound plate fabricates the mixed powder which mixes and changes and sinters the copper below 40wt% (Cu), and the silicon carbide (SiC) and remainder molybdenum (Mo) of 0.5-5 [wt%], it is produced by rolling out. For many properties of this high heat dissipation nature metal compound plate, an average coefficient of thermal expansion is in the range of 6.0-8.5 [x10-6/degree C], and consistencies are 10 g/cm3. While being the following, thermal conductivity is 200 or more W/m-K.
[0018] If joggling is performed to such a high heat dissipation nature metal compound plate by joggling processing, a substrate is accomplished and a silicon semiconductor device is prepared on the substrate, the inclusion to a ceramic package is constituted as a suitable high heat dissipation nature metal substrate.
[0019] Then, about the high heat dissipation nature metal compound plate from which an ingredient presentation ratio (presentation content) differs based on some examples, the following doubles the manufacture approach and explains it concretely.
[0020] In the <example 1> example 1, first, as raw material powder, molybdenum (Mo) powder, electrolytic copper (Cu) powder, and silicon carbide (SiC) powder were mixed at a rate of 70:30:3.1, and after carrying out press forming, it sintered in the hydrogen ambient atmosphere. Next, after carrying out

heating maintenance of this sintered compact for 15 minutes at 900 degrees C in a hydrogen ambient atmosphere, and carrying out hot rolling processing, the plate with a thickness of 1.0mm was made by performing cold rolling processing.
[0021] then, the place which investigated many properties of this plate -- a coefficient of thermal expansion (alpha) -- 7.5x10-6/degree C and thermal conductivity (kappa) -- 220 W/m-K and a consistency (rho) -- 9.7 g/cm3 it was .
[0022] Moreover, after forming nickel (nickel) plating so that thickness may be set to 3 micrometers by electrolysis at this plate, when it heat-treated under the conditions for 850 degree-Cx 20 minutes and membrane formation workability was investigated in the hydrogen ambient atmosphere, it blisters about plating, there is no deterioration of discoloration, a stain, etc., and the defect was not accepted.
[0023] the place which investigated many properties about the plate which incidentally produced (Molybdenum Mo) powder:electrolytic copper (Cu) powder in the procedure same as 70:30, without including silicon carbide (SiC) as a comparison -- a coefficient of thermal expansion (alpha) -- 7.7x10-6/degree C and thermal conductivity (kappa) -- 190 W/m-K and a consistency (rho) -- 9.7 g/cm3 it was .
[0024] In the <example 2> example 2, as raw material powder, molybdenum (Mo) powder, electrolytic copper (Cu) powder, and silicon carbide (SiC) powder were mixed at a rate of 70:30:4.2, and the plate with a thickness of 1.0mm was produced through the same procedure as an example 1 after this.
[0025] then, the place which investigated many properties of this plate -- a coefficient of thermal expansion (alpha) -- 7.3x10-6/degree C and thermal conductivity (kappa) -- 230 W/m-K and a consistency (rho) -- 9.7 g/cm3 it was .
[0026] Moreover, after performing and heat-treating nickel plating like the case of an example 1 here, when **** (BAg-8) attachment was further performed to the silicon wafer, nickel plating and the adhesion workability of **** were good, and defects, such as a crack and exfoliation, were not accepted.
[0027] When the process to ** attachment was similarly performed about the plate which incidentally produced (Molybdenum Mo) powder:electrolytic copper (Cu) powder as 70:30, without including silicon carbide (SiC) as a comparison also here, the crack was accepted in the ** attachment section and it turned out that adhesion workability deteriorates.
[0028] In the <example 3> example 3, as raw material powder, molybdenum (Mo) powder, electrolytic copper (Cu) powder, and silicon carbide (SiC) powder were mixed at a rate of 80:20:4.2, and the plate with a thickness of 1mm was produced through the same procedure as an example 1.
[0029] then, the place which investigated many properties of this plate -- a coefficient of thermal expansion (alpha) -- 6.7x10-6/degree C and thermal conductivity (kappa) -- 210 W/m-K and a consistency (rho) -- 9.8 g/cm3 it was .
[0030] Moreover, it was good, when nickel plating and **** attachment were given like the case of an example 2 also here and adhesion workability was investigated.
[0031] the place which investigated many properties about the plate which incidentally produced (Molybdenum Mo) powder:electrolytic copper (Cu) powder in the procedure same as 80:20, without including silicon carbide (SiC) as a comparison also here -- a coefficient of thermal expansion (alpha) -- 6.9x10-6/degree C and thermal conductivity (kappa) -- 175 W/m-K and a consistency (rho) -- 9.9 g/cm3 it was .
[0032] In the <example 4> example 4, as raw material powder, molybdenum (Mo) powder, electrolytic copper (Cu) powder, and silicon carbide (SiC) powder were mixed at a rate of 90:10:5.3, and the plate with a thickness of 1mm was produced through the same procedure as an example 1.
[0033] Then, when many properties of this plate were investigated, the coefficient of thermal expansion (alpha) was [202 W/m-K and the consistency (rho) of 6.0x10-6/degree C and thermal conductivity (kappa)] 10.0 g/cm3.
[0034] the place which investigated many properties about the plate which incidentally produced (Molybdenum Mo) powder:electrolytic copper (Cu) powder in the procedure same as 90:10, without including silicon carbide (SiC) as a comparison also here -- a coefficient of thermal expansion (alpha) -- 6.2x10-6/degree C and thermal conductivity (kappa) -- 163 W/m-K and a consistency (rho) -- 10.0 g/cm3 it was .
[0035] In addition, the particle size is 1-3 [mum] about the SiC powder used in each above example (1-4), and, for a consistency (rho), 2.5 g/cm3 and a coefficient of thermal expansion (alpha) are [3.1x10-6/degree C and the thermal conductivity (kappa) of many properties] 280 W/m-K.
[0036] After regulating the content of Cu less than [40wt%] from each example (1-4) on the occasion of production of the Cu-Mo system composite material (TT-RCM) by known powder alligation, If the SiC powder of 0.5-5 [wt%] is added and a high heat dissipation nature metal compound plate is obtained,

when lightweight-izing and low-fever expansion-ization will be embodied and high heat dissipation nature will improve, it turns out that machinability also becomes good.

[0037] By the way, to each plate obtained in each above example (1-4), as shown in drawing 1 After performing convex type joggling by joggling processing and producing four sorts of separate substrates 1 with ******, After forming a silicon chip 2 with solder 3 on each of these substrates 1 with ******, respectively and obtaining four sorts of high heat dissipation nature metal substrates, Where each of these high heat dissipation nature metal substrates are built into a ceramic package, when the heat cycle test was performed, there is no generating of a crack etc. also about which case, and the exfoliation from a junction interface was not accepted, either. Moreover, the heat dissipation nature in an actual assembly condition was also understood that it is improving sharply compared with the conventional thing.

[0038]

[Effect of the Invention] After regulating the content of Cu less than [40wt%] on the occasion of production of the Cu-Mo system composite material (TT-RCM) by known powder alligation according to this invention as stated above, by adding the SiC powder of 0.5-5 [wt%], heat dissipation nature is high, moreover it is lightweight at a low-fever expansion coefficient, and the high heat dissipation nature metal compound plate which was excellent in machinability comes to be obtained. Moreover, if joggling is performed using this high heat dissipation nature metal compound plate as a substrate ingredient, a substrate is produced and a silicon semiconductor device is prepared on that substrate, a high heat dissipation nature metal substrate suitable [especially the inclusion to a ceramic package] and effective will come to be obtained.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.
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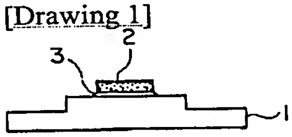
DRAWINGS

[Drawing 1]



[Translation done.]

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 4th partition of the 3rd section
[Publication date] April 10, Heisei 13 (2001. 4.10)

[Publication No.] JP,9-143649,A
[Date of Publication] June 3, Heisei 9 (1997. 6.3)
[Annual volume number] Open patent official report 9-1437
[Application number] Japanese Patent Application No. 7-308885
[The 7th edition of International Patent Classification]

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C22F   1/18
H01L  23/373
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[FI]

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C22F   1/18      C
H01L  23/36      M
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[Procedure revision]
[Filing Date] July 24, Heisei 12 (2000. 7.24)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] 0027
[Method of Amendment] Modification
[Proposed Amendment]
[0027] When the process to ** attachment was similarly performed about the plate which incidentally produced (Molybdenum Mo) powder:electrolytic copper (Cu) powder as 70:30, without including silicon carbide (SiC) as a comparison also here, the crack was accepted in the ** attachment section and it turned out that adhesion workability is inferior.

[Translation done.]